What is claimed is:

1. An optical amplifier for supplying a pumping light to an optical amplification medium to amplify a signal light,

wherein a light different from said signal light is given on an optical path including said optical amplification medium, and based on a state of the light or a state of another light generated on said optical path by the light, a supply condition of the pumping light to said optical amplification medium is controlled.

2. An optical transmission system for transmitting a WDM light from a transmission station to a reception station, utilizing an optical amplifier in claim 1,

wherein said optical amplifier is a Raman amplifier comprising:

an optical amplification medium;

a pumping light source generating a plurality of pumping lights having wavelengths different from each other;

an optical device introducing said plurality of pumping lights to said optical amplifying medium; and

control means for controlling said pumping light source,

said transmission station sends out a plurality of reference lights having wavelengths at which respective Raman gains obtained by said plurality of pumping lights reach peaks, or wavelengths close to said wavelengths, and

said control means controls said plurality of pumping lights based on the optical powers of said plurality of reference lights.

3. An optical transmission system for transmitting a WDM light from a transmission station to a reception station, utilizing an optical amplifier in claim 1,

wherein said optical amplifier is a Raman amplifier comprising:

an optical amplification medium;

a pumping light source generating a plurality of pumping lights having wavelengths different from each other;

an optical device introducing said plurality of pumping lights to said optical amplifying medium; and

control means for controlling said pumping light source,

said transmission station sends out a plurality of reference lights corresponding to said plurality of pumping lights at frequencies shifted by a Raman shift frequency or at frequencies close to said frequencies, and

said control means controls said plurality of pumping lights based on the optical powers of said plurality of reference lights.

4. An optical transmission system according to claim 2 or claim 3,

wherein said transmission station sends information to said reception station utilizing at least a part of said plurality of reference lights.

5. An optical transmission system according to claim 2,

wherein, in the case where said WDM signal light is arranged on frequency grids in which a previously determined frequency interval is defined, said plurality of reference lights is arranged on grids closest to a frequency corresponding to a wavelength determined based on the pumping lights.

6. An optical transmission system according to claim 3,

wherein, in the case where said WDM signal light is arranged on frequency grids in which a previously determined frequency interval is defined, said plurality of reference lights is arranged on grids closest to a frequency determined based on the pumping lights.

7. An optical transmission system according to claim 2 or claim 3, further comprising;

detecting means for detecting the optical powers of said plurality of reference lights contained in said WDM light,

wherein said control means controls the optical powers of said plurality of pumping lights so that the optical powers of the plurality of reference lights detected by said detecting means are equalized.

8. An optical transmission system according to claim 7,

wherein said detecting means is an optical spectrum analyzer.

9. An optical transmission system according to claim 7,

wherein said detecting means comprises reflecting means for selectively reflecting said plurality of reference lights, and light receiving means for converting the reference light reflected by said reflecting means into an electric signal.

10. An optical transmission system according to claim 2 or claim 3,

wherein said control means controls said plurality of pumping lights based on an average value of the respective optical powers of said plurality of reference lights.

11. An optical transmission system according to claim 2 or claim 3,

wherein said control means controls the output power of said WDM light based on an average value of the respective optical powers of said plurality of reference lights.

12. An optical transmission system for transmitting a WDM light from a transmission station to a reception station via a repeater station, utilizing an optical amplifier in claim 1,

wherein said repeater station includes a Raman amplifier comprising:

a pumping light source generating a plurality of pumping lights having wavelengths different from each other;

an optical device introducing said plurality of pumping lights to an optical amplifying medium; and

control means for controlling said pumping light source,

said transmission station comprises;

reference light generating means for generating a plurality of reference lights having wavelengths at which respective Raman gains obtained by said plurality of pumping lights reach peaks, or wavelengths close to said wavelengths,

said repeater station further includes:

a discrete optical amplifier amplifying said WDM light; and

auxiliary light supply means for multiplexing an auxiliary light having a wavelength same as that of the reference light positioned outside a gain band of said discrete optical amplifier among said plurality of reference lights, with said WDM light, and

said control means controls said plurality of pumping lights based on the respective optical powers of said plurality of reference lights.

13. An optical transmission system according to claim 12,

wherein said repeater station comprises;

auxiliary light supply means for superimposing supervisory information on the reference light positioned outside the gain band of said discrete optical amplifier, among said plurality of reference lights, converting the reference light into an electric signal at the repeater station, and further converting the electric signal into an optical signal, to multiplex the optical signal with said WDM light, and

said control means controls said plurality of pumping lights based on the respective optical powers of said plurality of reference lights including the reference light positioned outside the gain band, and further remote controlling the repeater station using the reference light outside the gain band, to repeatedly transmit the supervisory information.

14. An optical transmission system for transmitting a WDM light from a transmission station to a reception station via a repeater station, utilizing an optical amplifier in claim 1,

wherein said repeater station includes a Raman amplifier comprising:

a pumping light source generating a plurality of pumping lights having wavelengths different from each other;

an optical device introducing said plurality of pumping lights to an optical amplifying medium; and

control means for controlling said pumping light source,

said transmission station comprises;

reference light generating means for generating a plurality of reference lights having wavelengths at which respective Raman gains obtained by said plurality of pumping lights reach peaks, or wavelengths close to said wavelengths, and

said control means controls said plurality of pumping lights based on the respective optical powers of said plurality of reference lights.

15. An optical amplifier according to claim 1,

wherein, in an optical transmission system for transmitting a WDM light containing a plurality of signal lights and a plurality of reference lights from a transmission station to a reception station, a Raman amplifier amplifying said WDM light is used,

said Raman amplifier comprises:

an optical amplification medium;

a pumping light source generating a plurality of pumping lights having wavelengths different from each other;

an optical device introducing said plurality of pumping lights to said optical amplifying medium; and

control means for controlling said plurality of pumping lights based on the respective optical powers of said plurality of reference lights, and

said plurality of reference lights is arranged in wavelengths at which respective Raman gains obtained by said plurality of pumping lights reach peaks, or wavelengths close to said wavelengths.

16. An optical transmission method for transmitting a WDM light from a transmission station to a reception station, utilizing a Raman amplifier using a plurality of pumping lights having wavelengths different from each other,

wherein said transmission station sends out a plurality of reference lights having wavelengths at which respective Raman gains obtained by said plurality of pumping lights reach peaks, or wavelengths close to said wavelengths, as a part of said WDM light, and

said Raman amplifier controls said plurality of pumping lights based on the respective optical powers of said plurality of reference lights.

17. An optical amplifier according to claim 1,

wherein a Raman amplifier amplifying signal lights due to a Raman effect occurring in the optical amplification medium, is used,

said Raman amplifier comprises:

a pumping light supply section that supplies pumping lights to the optical amplification medium;

an output light monitoring section that measures the power of a light, which is propagated through the optical amplification medium to be output;

an amplified spontaneous Raman scattering light processing section that supplies, in the preparation state before starting the operation, the pumping lights to the optical amplification medium to be actually used in the operation time, to measure the power of an amplified spontaneous Raman scattering light generated in said optical amplification medium, and based on the measured amplified spontaneous Raman scattering light power, obtains a coefficient of a modeling formula for calculating the amplified spontaneous Raman scattering light power after starting the operation;

a storing section that stores the coefficient obtained by said amplified spontaneous Raman scattering light processing section;

an amplified spontaneous Raman scattering light calculating section that calculates, in accordance with the modeling formula to which the coefficient stored in said storing section is applied, the power of the amplified spontaneous Raman scattering light generated after starting the operation, according to the powers of the

pumping lights supplied to the optical amplification medium from said pumping light supply section; and

a pumping light control section that corrects the output light power measured by said output light monitoring section using the amplified spontaneous Raman scattering light power calculated by said amplified spontaneous Raman scattering light calculating section, to control an operation of said pumping light supply section based on the corrected output light power.

18. An optical amplifier according to claim 17,

wherein said pumping light supply section includes a plurality of pumping light sources having wavelengths different from each other, and

said amplified spontaneous Raman scattering light processing section obtains said coefficient of the modeling formula, using the amplified spontaneous Raman scattering light power measured by said output light monitoring section when said plurality of pumping light sources are driven individually, and the amplified spontaneous Raman scattering light power measured by said output light monitoring section when two of said plurality of pumping light sources are combined with each other to be driven.

19. An optical amplifier according to claim 18,

wherein said amplified spontaneous Raman scattering light processing section verifies said coefficient of the modeling formula, using the amplified spontaneous Raman scattering light measured by said output light monitoring section when all of said plurality of pumping light sources are driven.

20. An optical amplifier according to claim 17,

wherein said optical amplification medium is a transmission optical fiber, and has a backward pumping configuration in which said pumping light supply section is arranged on a signal light output side of said transmission optical fiber.

21. An optical amplifier according to claim 17,

wherein said pumping light control section feedback controls said pumping light supply section, so that said corrected output light power is fixed at a previously set level.

22. An optical amplifier according to claim 17,

wherein said pumping light control section stops the supply of pumping lights or performs a shutdown control for suppressing the pumping light power to a

predetermined level or less, when said corrected output light power is reduced to a previously set threshold or below.

23. An optical amplifier according to claim 17,

wherein said output light monitoring section divides the light, which is propagated through the optical amplification medium to be output, into a plurality of wavelength blocks, to measure the output light power corresponding to each wavelength block, and

said pumping light control section corrects the output light power corresponding to each wavelength block measured by said output light monitoring section, using the amplified spontaneous Raman scattering light calculated by said amplified spontaneous Raman scattering light calculating section, and based on said corrected output light power of each wavelength block, controls a supply condition of the pumping lights so that a wavelength characteristic of the Raman amplified signal light approaches a target wavelength characteristic.

24. An optical amplification system comprising a Raman amplifier in claim 17 and a rare-earth element doped fiber amplifier cascade connected with said Raman amplifier.

25. An optical amplification system according to claim 24,

wherein there is provided a circuit comprising: respective functions of said amplified spontaneous Raman scattering light processing section and said amplified spontaneous Raman scattering light calculating section, and a function of executing the signal processing for controlling an operation of said rare-earth element doped fiber amplifier, to collectively manage the operations of said Raman amplifier and said rare-earth element doped fiber amplifier.

26. An optical transmission system for repeatedly transmitting a signal light transmitted from a signal light transmission apparatus to an optical transmission path, while amplifying the signal light by an optical repeater arranged on the optical transmission path,

wherein said optical repeater comprises a Raman amplifier in claim 17.

27. An optical transmission system according to claim 26,

wherein said optical repeater is arranged on the optical transmission path in plural numbers,

there is provided a subsidiary signal light transmitting section that transmits a subsidiary signal light for controlling said each optical repeater, between the respective optical repeaters, and

timing for making said amplified spontaneous Raman scattering light processing section to execute the processing of obtaining the coefficient of the modeling formula, and timing for making said pumping light control section to execute the control of said pumping light supply section, in said each optical repeater, are notified to said each optical repeater via said subsidiary signal light.

28. An optical transmission system according to claim 26,

wherein said optical repeater comprises a rare-earth element doped fiber amplifier cascade connected with said Raman amplifier.

29. An optical amplifier according to claim 1, comprising:

a pumping unit supplying pumping lights to said optical amplification medium;

a connecting loss measuring section that inputs a measuring light, which is different from the signal light, to the optical path between said pumping unit and said optical amplification medium, and based on a reflected light and a backward scattering light of the measuring light, which are generated in said optical path, measures connecting losses at one or more connecting points existing on said optical path; and

a control section that controls the supply condition of the pumping lights by said pumping unit, according to the connecting losses measured by said connecting loss measuring section.

30. An optical amplifier according to claim 29,

wherein said connecting loss measuring section measures the loss distribution in a longitudinal direction of said optical path, utilizing the optical time domain reflectometry.

31. An optical amplifier according to claim 30,

wherein said connecting loss measuring section includes:

a pulse light source generating a pulse signal having previously set pulse width and pulse interval;

a multiplexer/demultiplexer inputting the optical pulse signal from said pulse light source to said optical path and also extracting a reflected light and a backward scattering light of said optical pulse signal;

a light receiver detecting the powers of the reflected light and the backward scattering light extracted by said multiplexer/demultiplexer; and

a signal processing circuit leading out the connecting losses at one or more connecting points existing on said optical path so as to correspond to the longitudinal position of the optical path, according to a signal indicating a detection result of said light receiver.

32. An optical amplifier according to claim 29,

wherein said connecting loss measuring section measures the loss distribution in the longitudinal direction of said optical path, utilizing the optical frequency domain reflectometry.

33. An optical amplifier according to claim 32,

wherein said connecting loss measuring section includes:

a frequency sweeping light source outputting an optical signal of which frequency is linearly swept in temporal;

an optical coupler branching an output light from said frequency sweeping light source to a measuring light and a reference light, to output the measuring light to said optical path and the reference light to a reference port, and also multiplexing the reflected light and backward scattering light of said measuring light, with a reflected light of said reference light, to generate a beat signal light;

a light receiver detecting the beat signal light generated by said optical coupler;

a calculating circuit performing the high speed Fourier transform on a signal indicating a detection result of said light receiver; and

a signal processing circuit leading out the connecting losses at one or more connecting points existing on said optical path so as to correspond to the longitudinal position of the optical path.

34. An optical amplifier according to claim 29,

wherein said pumping unit generates pumping lights capable of amplifying due to a Raman effect the signal light being propagated through said optical amplification medium, to supply said pumping lights to said optical amplification medium.

35. An optical amplifier according to claim 34,

wherein said pumping unit supplies pumping lights, which are propagated in a direction opposite to a propagation direction of the signal light, to the optical amplification medium connected with a signal light input side.

36. An optical amplifier according to claim 29,

wherein said control section controls said pumping unit so that the supply of the pumping light is stopped or reduced to a predetermined power level or less, when the connecting loss measured by said connecting loss measuring section reaches a previously set threshold or above, and also outputs the warning notifying a connection abnormality.

37. An optical amplifier according to claim 29,

wherein said connecting loss measuring section uses, as the measuring light, a pumping light generated by switching a drive system of the pumping light source included in said pumping unit to a drive system different from that at a normal operation time, when measuring the connecting loss.

38. An optical amplifier according to claim 37,

wherein said connecting loss measuring section switches a drive system of any one of a plurality of pumping light sources included in said pumping unit, when measuring the connecting loss.

39. An optical amplifier according to claim 29, further comprising:

a dry gas supply section that sprays a dry gas on a connection end surface of an optical connector used at one or more connecting points existing on the optical path between said pumping unit and said optical amplification medium,

wherein said control section controls said dry gas supply section so that the dry gas is sprayed on a connection end surface of the optical connector, when the connecting loss measured by said connecting loss measuring section reaches a previously set threshold or above.

40. An optical amplifier according to claim 29,

wherein an optical connector adhered at a ferule thereof to an optical fiber using the adhesive which is transparent to the light passing through the optical connector, and also a softening temperature thereof is higher than that of the resin adhesive, is used at

one or more connecting points existing on the optical path between said pumping unit and said optical amplification medium.

41. An optical amplifier according to claim 40,

wherein said adhesive of the optical connector is a glass material containing an additive which absorbs a light of wavelength band different from that of the light passing through the optical connector.

42. An apparatus using an optical amplifier in claim 29, including;

an optical switch inputting the measuring light generated by said connecting loss measuring section to a plurality of optical paths while performing the temporal switching,

wherein the connecting losses at one or more connecting points existing on said plurality of optical path are measured sequentially.